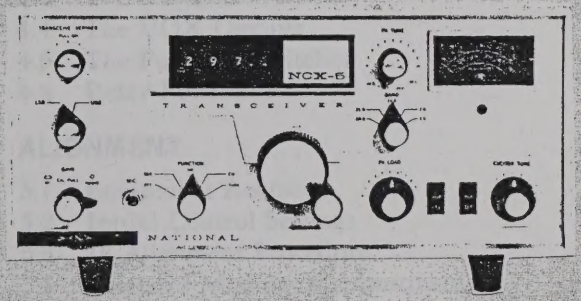
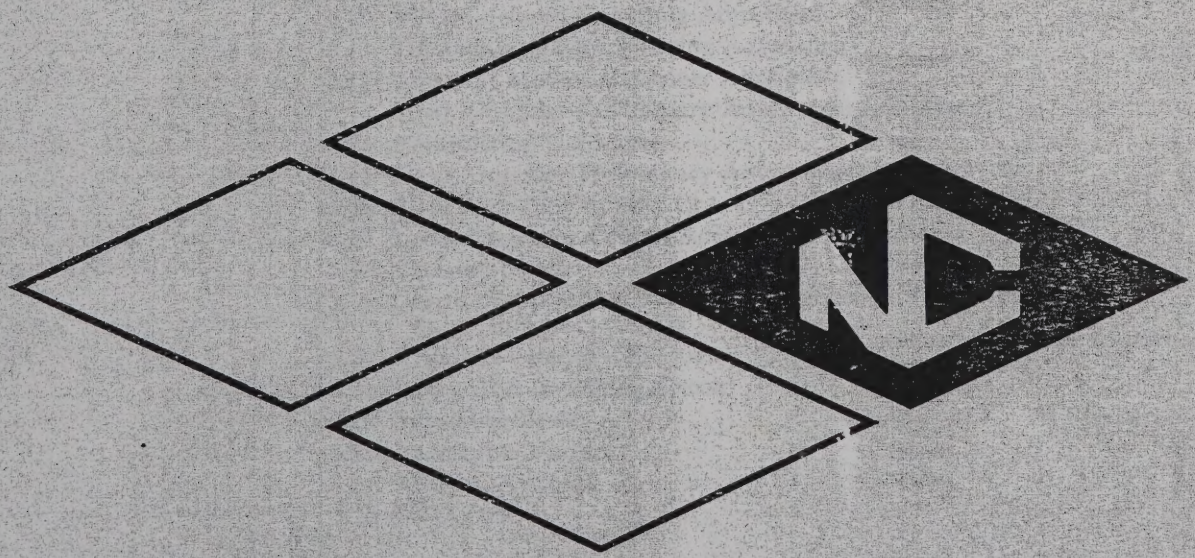
NATIONAL

NCX-5 TRANSCEIVER

Instruction Manual





NATIONAL RADIO COMPANY

INDEX

SECTION 2

INSTALLATION

2.1 POWER SUPPLIES:

The NCX-5 transceiver may be used with either the matching NCX-A 115/230 volt A.C. or the NCX-D 12 volt D.C. power supplies. We strongly recommend use of the National Power Supplies designed for the NCX-5 because of their extremely "stiff" voltage regulation and superior filtering.

NCX-A power supplies with serial numbers beginning with 73 or higher are designed for operation with the NCX-5 transceiver. NCX-A power supplies with serial numbers beginning with 44, 49, 57, 63, 69, or 72 *must be modified before use with the NCX-5 transceiver.* This modification may be easily made by connecting a 660 ohm 10 watt resistor in parallel with the two 330 ohm 10 watt resistors R-5 and R-6 in the NCX-A power supply. A partial schematic of the revised supply is shown on Figure #1.

2.2 MOBILE MOUNTING:

A mounting bracket is supplied as standard equipment with the NCX-5 transceiver. For mobile operation, this bracket should be mounted under the automobile dashboard with two #10, #12, or 1/4 x 20 screws. For maximum stability, these screws should be located as far apart as possible in the mobile mounting bracket. A pair of large threaded knobs hold the transceiver directly to the bracket. These knobs permit rapid installation or removal of the transceiver from the mount. Mobile operation usually results in considerable vibration and shock. For maximum frequency stability of the NCX-5 transceiver, it is important that all mounting screws used to hold the cabinet to the chassis and panel assembly be in place and firmly tightened. In mobile use, the rubber feet may be removed from the bottom of the NCX-5.

2.3 MICROPHONE CONNECTIONS:

The microphone input of the NCX-5 is equipped with a three circuit jack providing a ground on the main shank of the three circuit plug. The audio output of a high-impedance ceramic or dynamic microphone (a crystal microphone may be used, but is not recommended for mobile operation) should be connected to the ring of the three circuit jack. If the microphone is equipped with a push-to-talk button, the push-to-talk button should be so wired that the tip of the microphone plug is connected to the grounded shank of the plug when the push-to-talk button is pressed. The microphone push-to-talk button is connected to the —40 volt bias.

— CAUTION —

Accidental interchange of the wiring on the microphone plug will result in application of —40 volts to the microphone cartridge, which may damage the microphone.

The microphone input jack of the NCX-5 is equipped with a grounding contact so that no modulation of the transceiver is possible when the microphone plug is removed. Microphone connections are illustrated in Figure No. 1. We recommend the use of a good quality, wide-range microphone, since all necessary restriction of audio bandwidth is accomplished in the NCX-5 crystal lattice filter. The PTT circuit of the microphone should be modified to permit VOX operation without depressing the PTT button. This may be done by bending one of the shorting contacts inside the microphone so that it does not short the microphone cartridge terminals when the button is released.

2.4 MOBILE SPEAKER INSTALLATION:

When the NCX-5 is installed in an automobile for use with the NCX-D supply, it will usually be most convenient to use the speaker of the regular automobile broadcast radio. Two leads should be brought out of the 12 terminal Jones plug at the rear of the NCX-5 (pins 5 and 7) and connected to the speaker through a DPDT switch mounted under the dash to allow choice of speaker operation with either the NCX-5 or the standard broadcast radio.

2.5 AUXILIARY RELAY CONTROL TERMINALS:

A pair of SPST relay terminals rated at 3 amperes current capacity is provided at the rear of the NCX-5 to allow control of accessory equipment such as the NCL-2000 amplifier. Terminals are open during receive, closed during transmit.

SECTION 3
OPERATION

3.1 TUNING PROCEDURES:

3.1.1 PRELIMINARY ADJUSTMENT

— CAUTION —

BEFORE ATTEMPTING TO OPERATE THE NCX-5 TRANSCEIVER, THE FOLLOWING PRELIMINARY CONNECTIONS SHOULD BE MADE: A SUITABLE ANTENNA OR DUMMY LOAD PRESENTING 40 TO 60 OHMS RESISTIVE LOAD IMPEDANCE SHOULD BE CONNECTED TO THE ANTENNA TERMINALS, A PROPER POWER CABLE SHOULD BE CONNECTED FROM THE POWER SUPPLY TO THE NCX-5 TRANSCEIVER, AND A MICROPHONE OR KEY SHOULD BE CONNECTED TO THE APPROPRIATE INPUT JACKS. THE *FUNCTION SWITCH* SHOULD REMAIN IN THE *OFF* POSITION WHILE THESE CONNECTIONS ARE BEING MADE.

1. Set front panel controls as follows:

   MIC GAIN fully ccw (counterclockwise)

   TRANSCEIVE VERNIER in OFF position (pushed in)

   RF GAIN fully cw (clockwise)

   AUDIO GAIN at 9 o'clock

   BAND and MAIN TUNING to desired band and frequency

   PA TUNE, PA LOAD, and EXCITER TUNE fully ccw

   VOX-PTT switch in either position

   MOX-OFF switch: OFF

   SIDEBAND switch on desired sideband (usually LSB on the 80 and 40 meter bands, and USB on 20, 15, and 10 meter bands).

2. VOX GAIN, VOX DELAY, and MIC GAIN inside top cover should be set fully ccw, and CARRIER BALANCE at 12 o'clock.

3. BIAS adjust on rear panel should be set at 12 o'clock.

3.1.2 RECEIVER TUNE-UP (SSB)

1. Turn FUNCTION switch from OFF to SSB. After several seconds warm-up, the NCX-5 transmit-receive relay should close with an audible click. The NCX-5 is now in a receive condition on the selected band and frequency.

2. Adjust PA TUNE and EXCITER TUNE for maximum S-meter reading or background noise. This adjustment automatically sets up approximate transmit tuning since these controls are common for both transmitter and receiver.

3. Adjust AUDIO GAIN for comfortable listening level.

3.1.3 TRANSMITTER TUNE-UP (SSB)

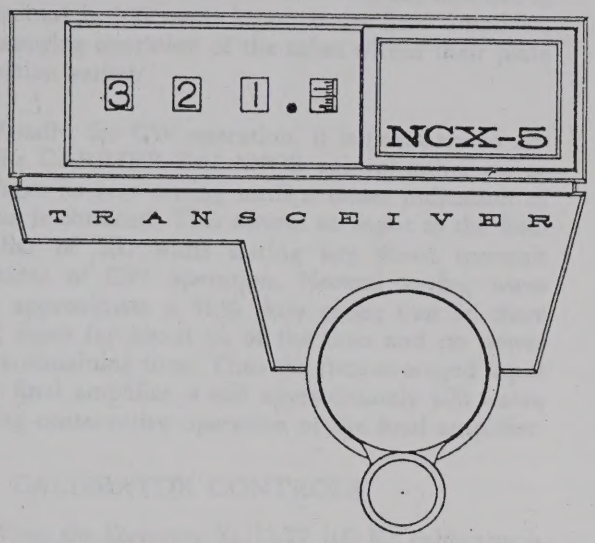
— CAUTION —

DO NOT PROLONG TUNE-UP PROCEDURES MORE THAN 30 SECONDS AT A TIME IN ORDER TO PREVENT UNNECESSARY OVERHEATING OF COMPONENTS DURING OUT-OF-RESONANCE CONDITIONS. AFTER EXPERIENCE IS GAINED, TUNE-UP MAY BE ACCOMPLISHED IN A MATTER OF A FEW SECONDS.

1. Turn FUNCTION switch to TUNE and adjust EXCITER TUNE for maximum meter reading.

2. Adjust PA TUNE for minimum meter reading (dip) indicating proper tuning of the Pi network. Slowly rotate the PA LOAD control cw and dip meter reading with P.A. TUNE control until meter reads 300 MA.

3.2.1 MAIN TUNING CONTROL AND DIGITAL DIAL READOUT



The NCX-5 transceiver incorporates a digital-type direct frequency readout to allow frequency adjustment to 1 Kc without interpolation between divisions. The VFO is accurate to 1 Kc, and it is read by adding the frequency in kilocycles shown on the counter dial to the frequency in megacycles shown on the BANDswitch. With the BANDswitch in the 14.0 Mc position, the frequency as shown in the illustration above is 14.321 Mc. If the BANDswitch were in the 3.5 Mc position, for example, the above frequency would be 3.5 Mc plus 321 Kc, or 3.821 Mc.

To provide even greater resettability, the NCX-5 readout incorporates a fourth window, as shown above, calibrated in ten one-hundred-cycle divisions. The illustration above actually indicates that 321 Kc plus 200 cycles (321.2 Kc) should be added to the BANDswitch frequency.

3.2.2 DIAL SET

The dial of the NCX-5 may be adjusted to exact frequency, such as a 100 Kc marker from the optional plug-in XCU-27 calibrator, by tuning to the marker frequency in the receiver and then by pulling *out* the main tuning knob of the NCX-5 and turning the knob until the dial reading corresponds to the known marker frequency.

3.2.3 THE FUNCTION SWITCH

Note the various interlocking features of the FUNCTION switch. In the SSB or AM positions of the FUNCTION switch, either VOX, MOX, or PTT operation may be used (see paragraphs 3.2.8 and 3.2.9). The rear panel key jack is disconnected in the SSB or AM positions, thus allowing a key to be left plugged into the NCX-5 at all times. Accidental closing of the key will not trip the unit to transmit if the FUNCTION switch is in either the SSB or AM position. In the SSB position, the product detector is in use, and in the AM position, the diode detector is selected. Bias is applied to the carrier oscillator during AM receiving periods, thus silencing the beat frequency oscillator of the receiver.

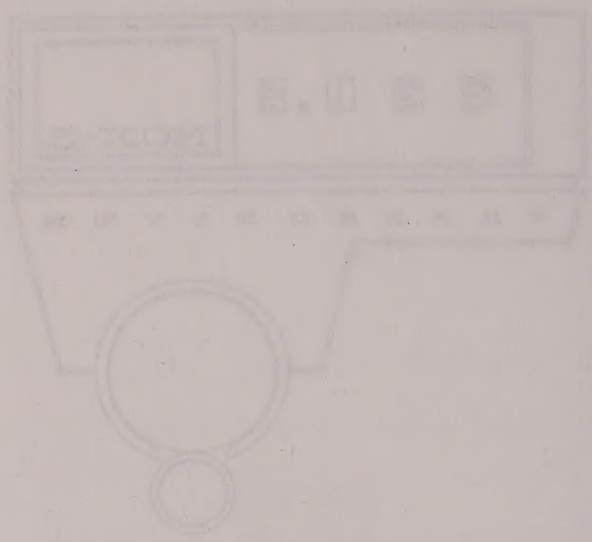
If the front panel FUNCTION switch is in the CW position, the rear panel key jack is connected for automatic break-in operation. At the same time, the plate of the microphone preamplifier is grounded to prevent accidental modulation of the transmitted signal by a microphone connected to the NCX-5. During CW operation, the VOX-PTT switch can be in either the VOX or PTT positions without any effect on the operation of the transceiver. The slight audio "beep" which may be heard from the loudspeaker at the beginning of each keying cycle is the result of the extremely fast attack time of the break-in CW circuit which eliminates "clipping" the first dot.

Finally, in the TUNE position of the FUNCTION switch, the keying circuit is internally grounded, placing the NCX-5 in transmit condition. At the same time, one of the deflection electrodes of the 7360 balanced modulator tube is grounded, unbalancing the tube and providing more than normal drive to the final amplifier for tune-up. It is important to note that if the FUNCTION switch is placed in the TUNE position, and an antenna is connected to the NCX-5, full power transmission of a CW note will occur and can cause unwanted interference. Tune-up procedure should therefore be limited to as short a time as possible.

3.2.4. THE PA TUNE AND PA LOAD CONTROLS

Adjustment of the PA TUNE and PA LOAD controls is interdependent. For normal tune-up, the FUNCTION switch is placed in the TUNE position. The EXCITER TUNE control is set for maximum meter indication. The PA TUNE control is then set for minimum indication, indicating resonance of the Pi network. For a normal 40 to 60 ohm resistive antenna, the PA LOAD control should be rotated clockwise to increase the meter reading. As this is done, there will be some interaction with the PA TUNE control, and it will be necessary to slightly adjust PA TUNE for minimum meter indication. As the PA LOAD control is advanced, the minimum meter reading will increase. Proper loading for 200 watts peak input occurs at 300 ma (marked in red on the meter scale). This loading current *should not be exceeded*, since the Pi network design is such that additional power input from a 700 volt supply will *not* result in additional power output. Above 300 ma the efficiency of the NCX-5 final amplifier will be impaired, and no further output will be obtained.

Proper operation of any linear final amplifier depends on proper idling current adjustment and on sufficient drive for adequate peak plate current during an off-resonance condition. The adjustment of the bias setting of the NCX-5 final amplifier is discussed



from the balance point until the meter indicates a final amplifier current of 150 ma. This corresponds to approximately 100 watts input to the final amplifier, thus assuring operation of the tubes within their plate dissipation rating.

Finally, for CW operation, it is necessary to adjust the CARRIER BALANCE control either cw or ccw from its zero setting until a meter indication of 300 ma is obtained. This assures an input to the final amplifier of 200 watts during key down transmit conditions of CW operation. Normal keying wave forms approximate a 50% duty cycle; that is, there is full input for about ½ of the time and no power for the remaining time. Thus the time-averaged input to the final amplifier is still approximately 100 watts, assuring conservative operation of the final amplifier.

3.2.6 CALIBRATOR CONTROLS

When the accessory XCU-27 100 Kc calibrator is plugged into the octal socket on the rear apron, 100 Kc crystal markers are available for precise calibration of the NCX-5. The calibrator is activated by means of a pull-push switch on the AUDIO GAIN control. The dial may then be set by following the instructions in paragraph 3.2.2.

3.2.7 S-METER ADJUSTMENT

Proper S-meter adjustment of the NCX-5 is obtained by disconnecting the antenna while the NCX-5 is set for SSB reception. With the RF GAIN fully clockwise (maximum gain), the S-meter adjustment (in front right corner of chassis) is rotated until the meter indicates between 0 and 1 "S" units.

3.2.8 VOX-PTT SWITCH AND VOX CIRCUIT ADJUSTMENTS

The VOX-PTT switch may be set to either mode, depending on preference and availability of a push-to-talk button on the microphone. Proper microphone jack connections are illustrated in figure No. 1.

Assuming that VOX operation is selected, the operator will find that the VOX GAIN and VOX DELAY control settings of the NCX-5 are remarkably free from interaction. The extreme VOX sensitivity available in the NCX-5 permits full anti-vox insertion at all times. As a result, no anti-vox control adjustment is required. With the VOX DELAY control fully ccw, VOX GAIN control is advanced slowly until the microphone just trips the NCX-5 to transmit with normal speech level. Mobile operation requires close talk to the microphone, since the high level of road, wind, and motor noises will otherwise tend to accidentally trip the VOX circuit. The VOX DELAY control is then adjusted for the desired release time.

It should be further noted that PTT and CW break-in operation are obtained through use of the VOX circuit. However, the VOX GAIN control will have no effect on this operation and may be left in any position. The VOX DELAY control is effective on both PTT and CW break-in operation and should be adjusted to the operator's liking for delay at the end of the transmission.

3.2.9 THE MOX-OFF SWITCH

The MOX-OFF switch in the MOX (manual operation) position places the NCX-5 in the transmit mode, regardless of the position of the VOX-PTT switch or the FUNCTION switch. This position is useful for manual operation when the microphone is not equipped with a PTT switch. When the MOX-OFF switch is returned to the OFF position, VOX or PTT operation may be selected by the VOX-PTT switch.

3.2.10 TRANSCEIVE VERNIER CONTROL

The TRANSCEIVE VERNIER control allows ± 5 Kc separation of the receive frequency from the transmit frequency of the NCX-5. It is actuated by pulling the control *out* and rotating the knob to increase or decrease receiver frequency. The transmit frequency of the NCX-5 remains unchanged at all times—*only the receiver frequency* is affected by the TRANSCEIVE VERNIER. The NCX-5 TRANSCEIVE VERNIER will be found to be extremely useful in AM or CW QSO's, as well as in SSB net operation. It allows the operator to tune to the desired AM or CW station with the VERNIER control pushed OFF, thus placing the transmit section of the NCX-5 on frequency. Then the TRANSCEIVE VERNIER can be pulled ON to offset receiver frequency enough to allow tuning of the station to the proper part of the filter passband for best copy without "walking" of the transmit signal.

To escape QRM during a QSO on SSB, the TRANSCEIVE VERNIER can be used to find a clear channel. Once a clear channel is found, the NCX-5 receiver is placed back on frequency simply by pushing the control IN, and arrangements may be made to QSY. The casual listener may also listen to two adjacent QSO's by merely turning the TRANSCEIVE VERNIER control on and off and thereby instantly place the NCX-5 receiver on either frequency.

3.2.11 MIC GAIN CONTROL

After the NCX-5 has been set up by proper tuning of the final amplifier and exciter stages and the CARRIER BALANCE control has been properly set for carrier balance, the MIC GAIN control should be advanced until the meter reads between 100 and 125 ma average on speech content from the microphone. The single sideband audio information so developed has a rapidly varying energy content and the meter will rapidly fluctuate between the 40 to 50 ma idling current and the 100 to 125 ma average meter reading. Actual peak current is about 300 ma.

SECTION 4

THEORY OF OPERATION

4.1 GENERAL:

The NCX-5 transceiver, designed to cover the 80 through 10 meter amateur bands, combines a double conversion superheterodyne receiver and single sideband transmitter, both employing a common crystal lattice filter. The final Pi network, mixer and driver tuning circuits of the transmitter also serve as RF circuits for the receiver. The carrier oscillator and VFO are common to the receiver and transmitter circuits while the receiver first IF stage is used as a low level amplifier in the transmitter-exciter function. The use of common filter and RF input components results in an extremely sensitive and image-free, selective receiver and in a high quality, low distortion SSB transmitter.

The operation of the NCX-5 is best understood by reference to the block diagram, figure 2, and the frequency chart, figure 3.

4.2 THE TRANSMITTER:

The transmit signal path of the NCX-5 is indicated on the block diagram by a dashed line starting at the mike jack and carrier oscillator. The microphone input circuit is designed for high-impedance dynamic or crystal microphones and provides for a push-to-talk microphone circuit. The microphone is connected directly to the grid of the pentode section of a 6GH8 (V8A) tube which operates as a preamplifier. The signal is then fed through the microphone gain control to one triode section of the 12AT7 (V6A) speech amplifier. The plate circuit of this speech amplifier is coupled to one of the deflection electrodes of the 7360 (V10) balanced modulator.

A 12AU7 (V7) tube is used for the two carrier oscillators. Each crystal is permanently connected to its triode section, and sideband switching is accomplished by applying a negative bias to the section to be turned off. The carrier signal appears across a common resistive plate load and is fed to the grid of the 7360 balanced modulator tube V-10. A D.C. network containing the carrier balancing control potentiometer is connected to the deflection electrodes of the 7360. In addition, a trimmer provides phase balance for maximum carrier suppression. The balanced primary winding is coupled to a single-ended secondary which serves as the input source for an eight-pole crystal lattice filter.

The crystal lattice filter is resistance terminated and coupled directly to the grid of the 12BA6 (V15) first IF stage. The single-tuned plate circuit is coupled to the grid of the 12BE6 (V3) first transmit mixer.

The VFO uses a 2N706 (Q1) NPN transistor oscillator and a 2N2188 (Q2) PNP transistor buffer. All biasing resistors and tank circuit capacitors are chosen for low noise and temperature characteristics. Power for the VFO circuits is double-regulated by a zener diode regulator fed from the regulated +150 volt bus. The result is a VFO circuit with a total drift from "turn on" of less than 100 cycles in any ten-minute period, including variations of external supply voltage and ambient temperature. The main tuning capacitor is completely linear with an accuracy of 1 Kc at any point within the 500 Kc tuning range. Output from the VFO is taken from the collector of the 2N2188 (Q2) and fed to the oscillator grid of the 12BE6 (V3) first transmit mixer.

The output from the first transmit mixer (V3) is always in the 3.5 to 4.0 Mc band. This signal is fed through a bandpass double-tuned circuit to the grid of the pentode section of the 6KE8 (V4B) second transmit mixer. The triode section of the 6KE8 is used as a crystal oscillator which feeds both the second transmit mixer and the first receive mixer.

The plate circuit of the second transmit mixer is single-tuned and feeds the grid of the 6GK6 (V5) driver. The single-tuned plate circuit of the driver feeds the grid of the final amplifier. The coils in the plate circuits of the transmit mixer and driver are band switched for the 80, 40, 20, 15, and 10 meter amateur bands. The tuning gang is tracked so that exciter tuning can be accomplished with only one control. The gains of the transmit mixer and driver are such that a driving signal in excess of 100 volts can be obtained at the grid of the final amplifier, thus assuring linear operation of the exciter to well above the level necessary for proper drive.

The final amplifier employs a pair of 6GJ5 (V1 and V2) tubes operating in parallel. A bias control on the rear apron sets proper idling current. The plates of the 6GJ5 final amplifier are coupled to a high-efficiency Pi network. The band switch selects proper inductance, tuning and load capacitance to match a 40 to 60 ohm resistive load over the entire 80, 40, 20, 15, and 10 meter amateur bands. The Pi network is designed for continuous operation at

The VOX and ANTI-VOX detector time constants are so arranged that the circuits will drive the relay tube grid negative in a very short time. At the end of transmision, the relay control signal cannot discharge backwards through the diodes. The discharge time is controlled by R7, the DELAY control which can be set from a fraction of a second to several seconds. This circuit is also used in the CW position and will be discussed later.

4.5 THE FUNCTION SWITCHES:

The following paragraphs describe the operation of the various switching circuits with the FUNCTION switch in all possible positions.

4.5.1 FUNCTION SWITCH OFF

In this position the FUNCTION switch interrupts the primary power, either directly in case of the NCX-A power supply or through a remote relay in the NCX-D 12 volt D.C. supply. The position of all other switches becomes irrelevant.

4.5.2 FUNCTION SWITCH SSB

In this position the following circuits are set up: The VOX-PTT switch, the product detector, and the microphone amplifier are connected into the circuitry. The key jack is disconnected to prevent accidental keying.

Now three different types of operation are possible:

4.5.2.1 VOX OPERATION

VOX switch in VOX position and the MOX-OFF switch in OFF position. In this combination the VOX and MOX switches ground the keying diode. Voice information from the microphone will override the ANTI-VOX, as described before, tripping the relay. The relay will transfer B+ to the final and other transmitting tubes. Negative bias is removed from various transmitting tubes and applied to receiving tubes and the first audio amplifier for quiet switch over. At the end of transmission and after the preset DELAY, the relay will pull in again, placing the set in receiving condition.

4.5.2.2 PUSH-TO-TALK OPERATION

VOX-PTT switch on PTT, MOX-OFF switch on OFF position. The output of the VOX amplifier is now shorted to ground, and the push-to-talk contact is connected across the transmit bias line. When the push-to-talk contact is pushed, the bias line (135) is grounded, which removes the disabling bias from transmitting tubes. The bias is also removed from the first transmit mixer. The screen of this mixer tube V3 (12BE6) will now draw current, causing a reduction of screen voltage. A voltage divider connected from this screen to the —80 bias line will develop a negative signal which is tied through the VOX-PTT and the MOX switch to the keying and PTT diode. The keying and PTT diode feeds the grid of the relay tube. The relay tube will be biased off, the relay falls out, and the set is in transmitting position.

The negative signal developed at the first transmit mixer screen is also fed to the product detector and audio output amplifier for quiet switching.

On release of the push-to-talk button, the negative bias reappears on the transmit tubes. The grid of the relay control tube returns to normal, the relay pulls in, and receiving conditions are restored.

4.5.2.3 MOX OPERATION

With the MOX switch in the MOX position, the transmitter bias line (135) is grounded directly. Switching occurs as with PUSH-TO-TALK operation. Returning the MOX switch to OFF will turn the transmitter off and put the set into receive condition.

4.5.3 FUNCTION SWITCH IN AM POSITION

The AM position of the FUNCTION switch transfers the input of the audio amplifier to the output of the AM detector. Also, disabling bias is applied to the carrier oscillator in use during receiving conditions to silence the BFO signal.

VOX, PTT, MOX operation functions now operate in the same manner as described under SSB (4.5.2).

4.5.4 FUNCTION SWITCH IN CW POSITION

In this position the FUNCTION switch will disconnect the VOX-PTT switch, ground the plate of the microphone preamplifier to prevent any speech information from coming through, connect the input of the audio amplifier to the output of the product detector, and connect the KEY jack to the transmitter bias line.

When the key is depressed the first time, the transmitter bias line (135) is grounded, placing the transmitter tubes and the first transmit mixer into operation. As described above under SSB operation, PUSH-TO-TALK (paragraph 4.5.2.2), the screen divider of the first transmit mixer will now actuate the relay tube through the keying diode. The relay will fall out, placing the NCX-5 into the transmitting position. From here on in, further keying is done by grid-block method, since the DELAY on the relay control tube will hold the transmit relay in for a predetermined time. Effective break-in keying is therefore realized. The VOX-PTT circuits are dis-

SECTION 5

NCX-5 TEST AND ALIGNMENT

NOTE:

TEST AND ALIGNMENT OF THE NCX-5 SHOULD ONLY BE PERFORMED BY COMPETENT, QUALIFIED PERSONNEL.

5.1 EQUIPMENT REQUIRED:

1. Signal generator providing output at the following frequencies: 6.0218 Mc, 3.5 Mc, 4 Mc, 7 Mc, 7.3 Mc, 14.0 Mc, 14.4 Mc, 21.0 Mc, 21.5 Mc, 28.0 Mc, 28.5 Mc, 29 Mc, 29.5 Mc.
2. Vacuum tube voltmeter (VTVM).
3. Standard output meter.
4. Sweep generator capable of sweeping at approximately 60 cycles per second over a frequency range from approximately 3 to 4.5 Mc.
5. High-frequency oscilloscope covering the range from DC to 30 Mc with a maximum sensitivity of 50 mv per centimeter or better and a low capacity input probe (Tektronix type 545 with type L preamplifier or equivalent).
6. External receiver capable of receiving at 9.72 Mc.
7. 50 ohm dummy load with calibrated output meter covering the frequency range from 3.5 to 30 Mc. (A high frequency vacuum tube voltmeter with a 100 volt full scale range may be substituted for the calibrated output power meter.)
8. Power supply capable of supplying +700 volts at 300 ma, +280 volts at 200 ma and −80 volts at 6 ma.
9. 1000 cycle audio generator with an output level of 10 mv.
10. High quality microphone equipped with push-to-talk button.
11. Transmitting key.
12. Suitable alignment tools for adjustment of coils and capacitors.
13. XCU-27 crystal calibrator.

5.2 INITIAL CONTROL SETTINGS:

FRONT PANEL

RF and AF GAIN	Full cw
FUNCTION Switch	OFF
PA TUNE	Full cw
PA LOAD and EXCITER TUNE	Full ccw
BANDSWITCH	3.5 Mc
TRANSCEIVE VERNIER	OFF
SIDEBAND Switch	USB
10-METER Switch	28.5 Mc
MOX-OFF Switch	OFF
VOX-PTT Switch	PTT

REAR PANEL

BIAS	Mid-range

INSIDE TOP COVER

MIC GAIN	Full ccw
CARRIER BALANCE	Full cw or ccw
VOX GAIN	Full ccw
VOX DELAY	Full ccw

Power Connections:

Connect the power supply with the 700 volt output turned off. The heater wire connecting the two 6GJ5 sockets should be removed.

5.3 IF ALIGNMENT PROCEDURE:

Turn the FUNCTION switch to SSB. In a few seconds the relay should close, indicating that the NCX-5 is in a receive condition.

Connect the audio output meter to the speaker leads. This may be conveniently done by plugging the audio output meter into the phone jack. Connect the signal generator through a 1000 pF capacitor to the grid (Pin 7) of the 12BE6 (V-14) second receive mixer. Set the signal generator for output at 6.0218 Mc. A 1 to 2Kc beat note should be heard. Align the slugs of the first, second, and third IF transformers (T-4, T-5, and T-6), as well as the bottom slug of the balanced modulator transformer (T-1) for maximum output, being careful to avoid overload of the receiving channel. The signal generator output should be reduced throughout this alignment procedure so that an output of 100 mw is never exceeded.

5.10 VFO SIDEBAND SWITCHING ADJUSTMENT:

Set the main tuning to zero beat at 3.8 Mc, rotate the sideband selector switch to LSB. The frequency obtained should still be zero beat. If it is not, set the sideband trimmer (C-16) for zero beat. As the sideband selector switch is rotated from LSB to USB, there should be no change of frequency. There is a small interaction of this adjustment with the VFO alignment. The VFO alignment should be readjusted if any error is introduced.

5.11 TEMPERATURE COMPENSATING ADJUSTMENT:

During alignment of the NCX-5, its VFO should be checked. If drift is excessive, the temperature compensating capacitor should be adjusted to provide greater or less compensation. Drift towards a lower dial reading on 80 meters indicates excessive temperature compensation and the compensating trimmer (C-18) should be turned to reduce capacity. A drift toward a higher dial reading indicates insufficient compensation and the trimmer should be turned for greater capacity. Adjustment of the compensating trimmer will change the VFO frequency. Complete realignment of the VFO can be avoided by the following procedures: Set the NCX-5 to zero beat at the 3.8 Mc dial setting. Adjust the compensating trimmer as required and immediately adjust the VFO trimmer (C-17) to return the NCX-5 to zero beat. If this procedure is carefully followed, the dial calibration should not be seriously affected. If a major correction has been made, the dial calibration should be checked and the alignment of the preceding sections should be repeated if necessary. Disconnect the signal generator leads from the NCX-5.

5.12 TRANSMIT MIXER AND DRIVER ALIGNMENT:

Connect the high-frequency oscilloscope to the junction of C-46, R-42, and the grids of the 6GJ5 final amplifier. Set the BAND switch to 3.5 Mc and the FUNCTION switch to TUNE. The relay should again drop out, indicating that the unit has been placed in a transmit condition. Set the main tuning dial to 3.750 Mc and the EXCITER control to 5. Adjust the 80 meter mixer coil (L-10) and the 80 meter driver coil (L-5) slugs for maximum indication on the oscilloscope. When the slugs are properly adjusted, the peak-to-peak output voltage on the oscilloscope should exceed 130 volts.

Set the BAND switch to 7.0 Mc and the EXCITER TUNE control to 6. Repeat the above procedure at 7.300 Mc while adjusting the 40 meter mixer coil (L-9) and the 40 meter driver coil (L-4). An output of more than 130 volts peak-to-peak must be indicated on the oscilloscope.

At this point a ripple will appear on the oscilloscope pattern. Adjust the harmonic trap (L-29) to minimize this ripple. After this adjustment is made, there will be some interaction with the tuning of the 40 meter mixer coil (L-9) which must be readjusted for maximum amplitude. Repeat these adjustments until minimum ripple and maximum amplitude are obtained simultaneously. The setting of the harmonic trap may be checked by removing the 11 Mc crystal in the high-frequency oscillator circuit. When the crystal is removed, there should be a large drop in the amplitude of the oscilloscope display. If there is no such drop, the harmonic trap has been mistuned and the slug should be withdrawn from the coil and the above alignment procedure repeated on the proper trap frequency.

Set the BAND switch to 14.0 Mc and the EXCITER TUNE control to 3. Repeat the above procedure at 14.250 Mc while adjusting the 20 meter mixer coil (L-8) and the 20 meter driver coil (L-3).

Set the BAND switch to 21.0 Mc and the EXCITER TUNE control to 7. Repeat the above procedure at 21.250 Mc while adjusting the 15 meter mixer coil (L-7) and the 15 meter driver coil (L-2).

Set the BAND switch to 28.5 Mc and the EXCITER TUNE control to 7. Repeat the above procedure at 28.750 Mc while adjusting the 10 meter mixer coil (L-6) and the 10 meter driver coil (L-1).

5.13 FINAL AMPLIFIER PRELIMINARY ADJUSTMENT (10 METER):

The NCX-5 construction does not provide for any alignment of the final amplifier. It is necessary at this time to check the final amplifier for proper operation at the high and low ends of all bands. In addition, it is necessary to make a slight final adjustment on the driver plate coils and on the neutralizing capacitor. These checks should be made in the following sequence: Connect the heater wire between the 6GJ5 sockets. Place the FUNCTION switch in the CW position and allow approximately 30 seconds for warm-up of the final amplifier tubes.

— CAUTION —

UP UNTIL THIS TIME, THERE HAS BEEN NO POWER APPLIED TO THE FINAL AMPLIFIER. ALL CIRCUITS WHICH HAVE BEEN OPERATING AND WHICH HAVE BEEN TESTED ARE LOW LEVEL CIRCUITS USING VOLTAGES AND POWER NORMALLY ENCOUNTERED IN DAY-TO-DAY RECEIVER WORK. FROM HERE ON, VOLTAGES AND CURRENTS MAY BE ENCOUNTERED WHICH ARE DANGEROUS TO PERSONNEL AND TO THE TEST EQUIPMENT AND THE UNIT UNDER TEST. IT IS ESSENTIAL TO BE SURE THAT NO PIECE OF TEST EQUIPMENT BE MISCONNECTED INTENTIONALLY OR ACCIDENTALLY TO THE NCX-5. IT IS FURTHER

Repeat this check with BAND switch and main tuning capacitor set for the following frequencies. If necessary, mixer and driver coils may be slightly re-adjusted to maintain proper tracking across the band providing sufficient drive and proper final amplifier operation is achieved.

BANDSWITCH	MAIN TUNING DIAL
29 Mc	29.25 Mc
29.5 Mc	29.75 Mc
21.0 Mc	21.00 Mc
21.0 Mc	21.50 Mc
14.0 Mc	14.00 Mc
14.0 Mc	14.50 Mc
7.0 Mc	7.00 Mc
7.0 Mc	7.30 Mc
3.5 Mc	3.50 Mc
3.5 Mc	4.00 Mc

5.17 LOCAL OSCILLATOR CRYSTAL ADJUSTMENT:

Set the BAND switch to 7.0 Mc. Turn the crystal calibrator ON. Tune to any crystal calibrator signal. The dial should read an exact 100 Kc point. Two beat notes may be noted. Adjust the 11 Mc crystal trimmer (C-9) and the main tuning dial to set both beat notes to zero.

Repeat this procedure on the 14.0 Mc band and set the 18 Mc crystal trimmer (C-10).

Repeat this procedure on the 21.0 Mc band and set the 25 Mc crystal trimmer (C-11).

The accessory crystal trimmers may also be set by this procedure according to the following chart:

BAND-SWITCH	10 METER SEGMENT SWITCH	CRYSTAL FRE-QUENCY	CRYSTAL TRIM-MER
28.0 Mc	28.0 Mc	24.5 Mc	C-14
28.0 Mc	29.0 Mc	25.5 Mc	C-13
28.0 Mc	29.5 Mc	26 Mc	C-12

5.18 PARASITIC CHECK:

Press the MOX-OFF switch to MOX. Adjust CARRIER BALANCE control for minimum current. Tune PA TUNE, PA LOAD, and EXCITER controls through their ranges. Look for unwanted spurious peaks on the meter. There should be none. Repeat this test on all bands.

5.19 CARRIER SUPPRESSION, SIDEBAND SUPPRESSION, MODULATION, AND ALC CHECKS:

Connect the audio generator to the microphone jack and supply 10 mv of audio signal to the NCX-5. Rotate the FUNCTION switch to the SSB setting. Connect the high-frequency oscilloscope to the antenna line which is connected to the dummy load. Rotate the CARRIER BALANCE control full cw or full ccw. Tune the final amplifier for maximum output at 300 ma input as described in the previous sections. A level well in excess of 100 volts peak-to-peak should be noted on the oscilloscope. Now slowly rotate the CARRIER BALANCE control towards mid-point. The oscilloscope level should fall and the meter reading should fall. Set the CARRIER BALANCE control for minimum indication on the oscilloscope which should correspond to minimum indication on the meter. Adjust the BIAS control for 60 ma on the meter. The level remaining on the oscilloscope should not exceed 0.5 volt peak-to-peak, thus insuring carrier suppression better than 50 db. If necessary, carefully adjust the balanced modulator plate trimmer (C-7) for minimum indication while rocking the CARRIER BALANCE control through minimum until the required 0.5 volt level is obtained.

Now rotate the MIC GAIN control slowly in a clockwise direction. A signal should again appear on the oscilloscope. The MIC GAIN should be advanced until the cathode current meter reads 250 ma. Output at the scope should be 120-180 volts. The wave form at this point should appear as indicated in figure 6A. It is necessary to note the level of ripple on the wave form to total wave form level. The ripple should not exceed 1/50 of the total wave form. This indicates that the unwanted sideband suppression with a 1000 cycle tone is in excess of 34 db.—the limit of this measuring technique.

It is important to note the difference between carrier balance and unwanted sideband suppression in the previous measurement. If the CARRIER BALANCE control is rotated slightly, the wave form of figure 6A will be altered to the wave form of figure 6B. If this wave form is present while attempting to make the sideband suppression measurement, the CARRIER BALANCE control should be slightly adjusted to compensate and return the picture to that of figure 6A.

Now further advance the MIC GAIN until the meter just reaches 300 ma as set by our previous tune-up procedure. Note the oscilloscope level. Slowly advance the CARRIER BALANCE control either cw or ccw from the balance setting. As this occurs, the wave form will begin to develop large cusps and peaks which will tend to exceed the noted oscilloscope level. Slowly reduce the MIC GAIN to keep the peaks at the predetermined level by carefully adjusting both the MIC GAIN and the CARRIER BALANCE control. It should be possible to obtain a picture as illustrated in figure 6C. It is important that the peaks of this figure be at exactly the level determined with the balanced carrier at 300 ma of cathode current. This is equivalent to a two-tone test and is useful in indicating distortion in the transmitter channel and performance of the modulating circuits. The wave form which is observed should have a clean sharp cusp and should have a sine wave envelope. There should be no flattening of the peaks and no broadening of the cusps. Typical incorrect wave forms are indicated in figure 6D & 6E.

oscilloscope while speaking into the microphone.

6. Set the FUNCTION switch to AM and repeat the above tests for PTT, VOX, and MOX operation.

7. While speaking into the microphone, adjust the CARRIER BALANCE control from the balance point and observe the introduction of carrier into the sideband signal on the oscilloscope.

8. Place the FUNCTION switch in the CW position. Advance the VOX GAIN control full cw (maximum sensitivity). Speaking into the microphone in this condition should not result in transmit-receive switching.

9. Set the VOX-PTT switch to PTT and press the PTT button. The NCX-5 should not switch into transmit.

10. Press the MOX-OFF switch to MOX. The NCX-5 should switch to transmit. Return the MOX-OFF switch to OFF.

11. Insert a key into the key jack. A tap of the key should place the NCX-5 into a transmit condition. Upon release of the key, the unit should revert to receive in 1/10 of a second to one second, depending on the setting of the VOX DELAY control.

12. Hold the key closed, speak into the microphone and advance the MIC GAIN control. There should be no evidence of modulation on the oscilloscope.

13. Set the transmitting key for a long series of dots. Adjust the CARRIER BALANCE control for transmitter output just below full power. Observe the series of keying pulses on the high-frequency oscilloscope. A proper keying pulse should appear as in figure 6G. Figure 6H and 6I indicate improper keying sequences.

14. Set the FUNCTION switch to TUNE. Observe that full power output is attained on the oscilloscope. Adjust the CARRIER BALANCE control. There should be no change in the output signal.

15. Speak into the microphone and advance the MIC GAIN control. There should be no evidence of modulation on the oscilloscope.

16. Return the FUNCTION switch to SSB.

5.23 TRANSCEIVE VERNIER:

Set the NCX-5 to 3.700 Mc. Tune the accessory receiver to 9.72 Mc and lightly couple to the NCX-5 VFO. Observe that the beat note may be varied more than ±5 Kc with the TRANSCEIVE VERNIER. Press the MOX-OFF switch to MOX. Observe that the beat note cannot be varied with the TRANSCEIVE VERNIER and that it corresponds to the beat note previously heard with the MOX-OFF switch OFF and the TRANSCEIVE VERNIER at mid-range. Turn the TRANSCEIVE VERNIER OFF and observe that the beat note does not change. Return the NCX-5 to receive.

Disconnect all test equipment.

— CAUTION —

IN THE FOLLOWING SERIES OF TESTS, THERE IS NO LOAD ON THE TRANSMITTER OUTPUT. IF THE UNIT SHOULD GO INTO TRANSMIT UNDER THIS CONDITION, SERIOUS DAMAGE CAN BE DONE TO THE FINAL OUTPUT STAGE. ALSO DURING THIS SERIES OF TESTS, A SIGNAL GENERATOR WILL BE CONNECTED TO THE ANTENNA TERMINALS. SERIOUS DAMAGE CAN BE DONE TO THIS SIGNAL GENERATOR IF THE UNIT IS ACCIDENTALLY PLACED INTO TRANSMIT.

5.24 ANTI-VOX CHECK:

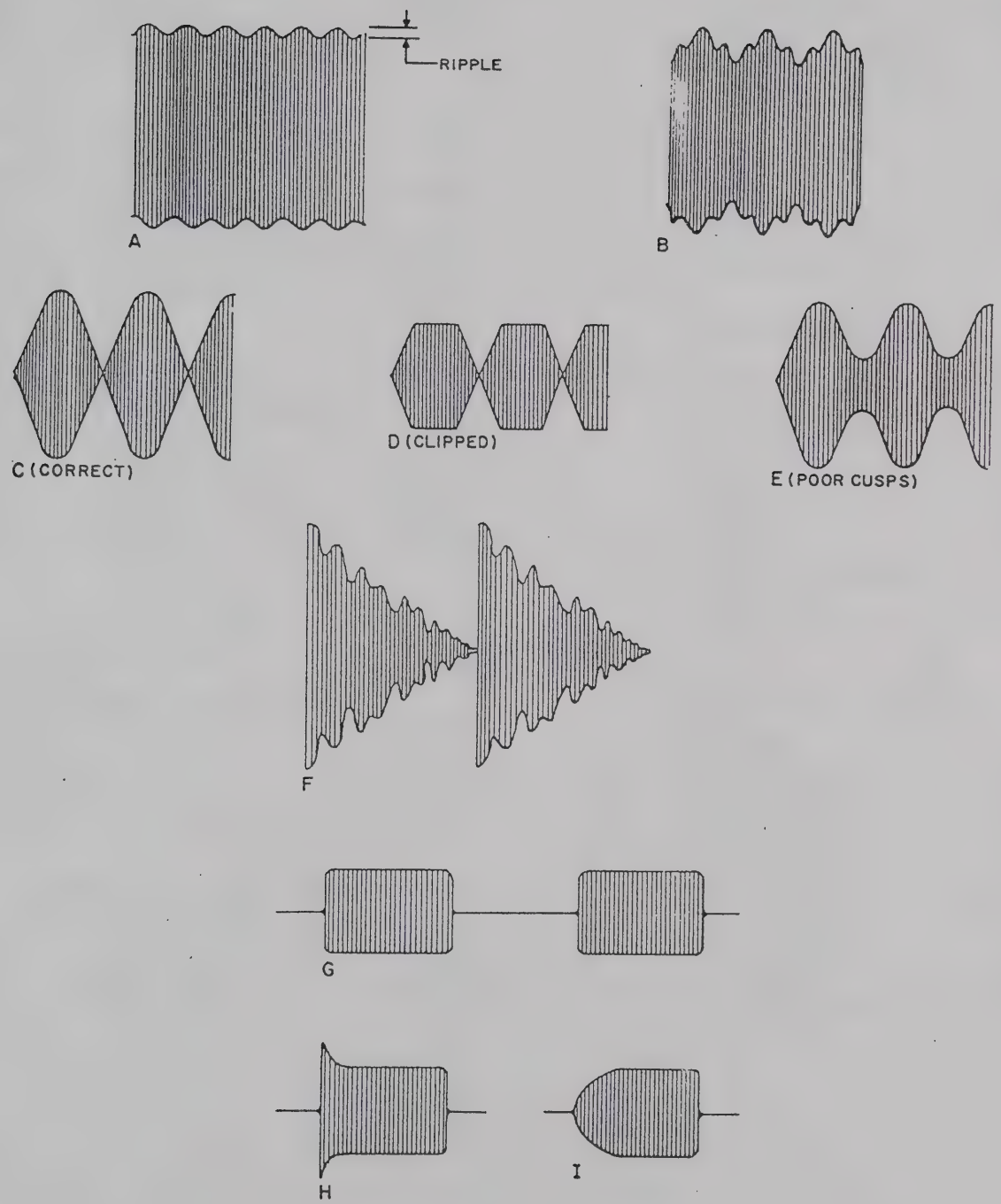
Connect the signal generator to the antenna terminals through a suitable dummy load to match the 50 ohm input impedance. Set the signal generator for 4.0 Mc, the BAND switch to 3.5 Mc, and the main tuning dial to 4.0 Mc until a beat note is obtained at a frequency of approximately 1000 cycles. Connect the power output meter to the audio output terminals by use of the phone jack. Set the AUDIO GAIN control for approximately ½ watt. Measure the D.C. voltage at the junction of D3, R103, R107, and C157. A voltage of more than +10 volts should be indicated at this test point.

5.25 VFO JACK:

Connect 100 ohms from the VFO jack to ground. The beat note should disappear, indicating that the VFO is not functioning. Feed an external signal into the VFO jack between 9.52 and 10.02 Mc. It should be possible to retune the beat note with the external signal. Remove the external signal and the 100 ohm resistor. The original beat note should reappear.

NCX-5 WAVE FORMS

FIGURE 6



COILS AND CHOKES (Cont)

L22	Choke 4.7 μh	C50523-5
L24, L25	Choke, Parasitic	B51545
L26	Choke, Antenna	C50523-3
L27	Coil VFO	B51520
L28	Choke VFO 3.3 μh	R1550-19

SWITCHES

S1-A	Bandswitch, SB Interlock, VFO	A51524
S1-BC	Bandswitch, SB Interlock, Carrier Osc.	A51522
S1-DE	Bandswitch, Mixer Output	A51521
S1-FG	Bandswitch, Driver Output	A51525
S1-HI	PA Bandswitch	A51523
S1	Detent	B51558
S1	Shaft	A50854
S2	Sideband Selector	B51526
S3-AB	Function Switch, Front	B51527
S3-CDE	Function Switch, Rear	B51541
S4	10 Meter Switch	B51549
S5	Rocker MOX-OFF	B51548-2
S6	Rocker VOX-PTT	B51548-1
S7	Part of Gain Controls	B51550
S8	Part of Transceive Vernier	B50986-2

KNOBS

Function, Sideband Selector, Bandswitch	NPS-7K2LA
PA Load, Exciter Tune, Transceive Vernier	NPS-7F2LA
PA Tune	NPS-7N1LC
Main Tuning	NPS-17D2LA
Audio Gain	NPS-7N3LC
Lever, RF Gain, 10 Meter Switch	A51399

SHAFTS, COUPLINGS, DRIVE TRAIN

Shaft, Function Switch	A51551
Shaft, PA Tune	A51561-1
Shaft, Exciter Tune	A50818-2
Shaft, PA Load	A50818-3

SHAFTS, COUPLINGS, DRIVE TRAIN (Cont)

Coup-Link	B25000
Bushing, Panel	A50840-0
Palnut 3/8-32	B19322-8
Coupling, Function Switch	J654-2
Coupling, Bandswitch	A12611
Drive Train, VFO, With Counter, Without Gang	A51681

COVERS

Cover, PA	C50815
Cover, VFO Top	B51560
Cover, VFO Bottom	B51587
Cover, Second Mixer	C51505

MISCELLANEOUS PARTS

Front Panel	E51502-5
Bushing, Hanger	A50817
Nuts for Above	A50117-7
Lockwasher for Above	5/8 KCE
Hanger Bracket	B50836
Hanger Screws	B50835
Hanger Pins	A50860-1
Cabinet	E51580-2
Foot, Rubber, Extension	A50850
Foot, Rubber	A50851
Cabinet Cover	D51579-3

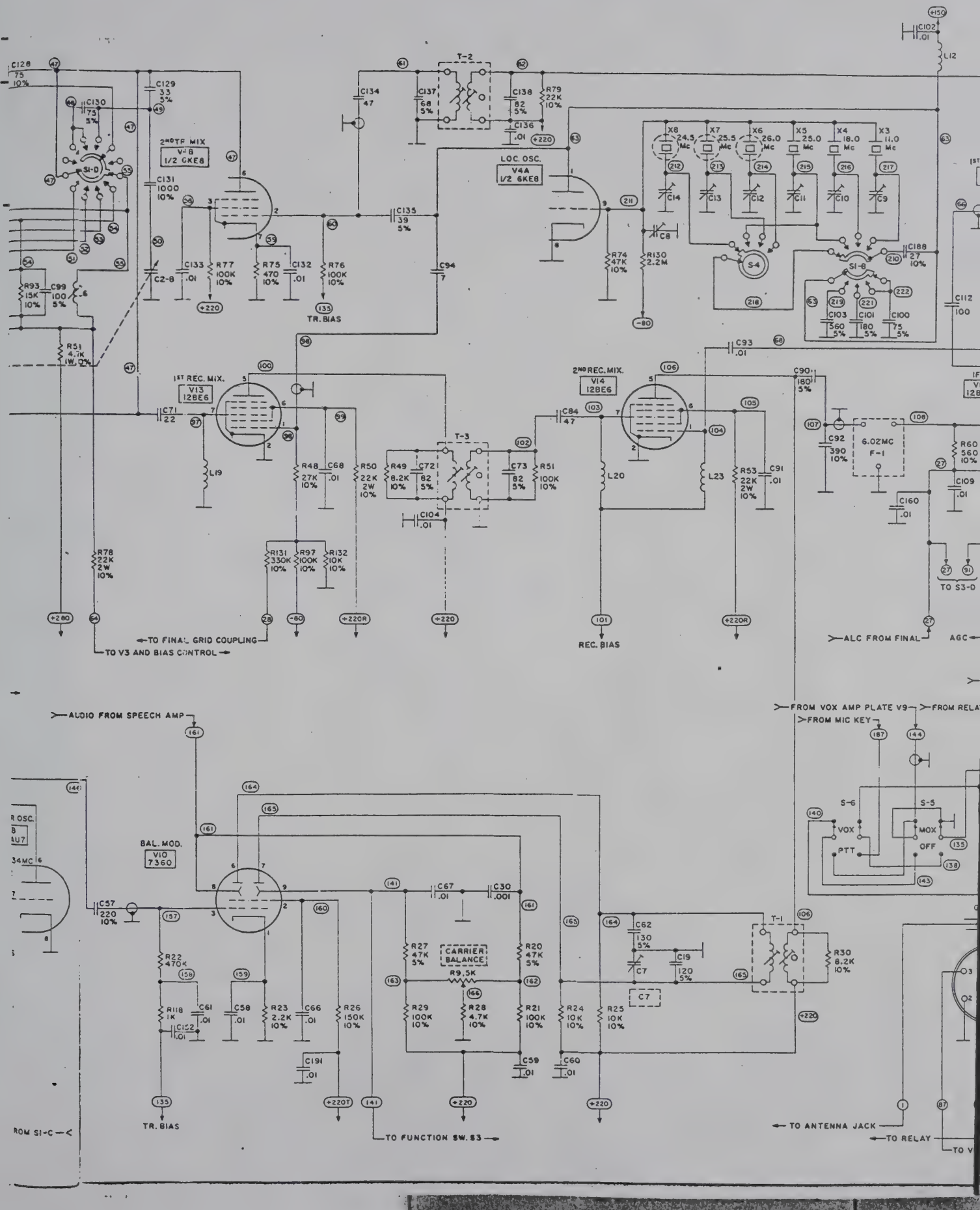
MISCELLANEOUS ELECTRICAL

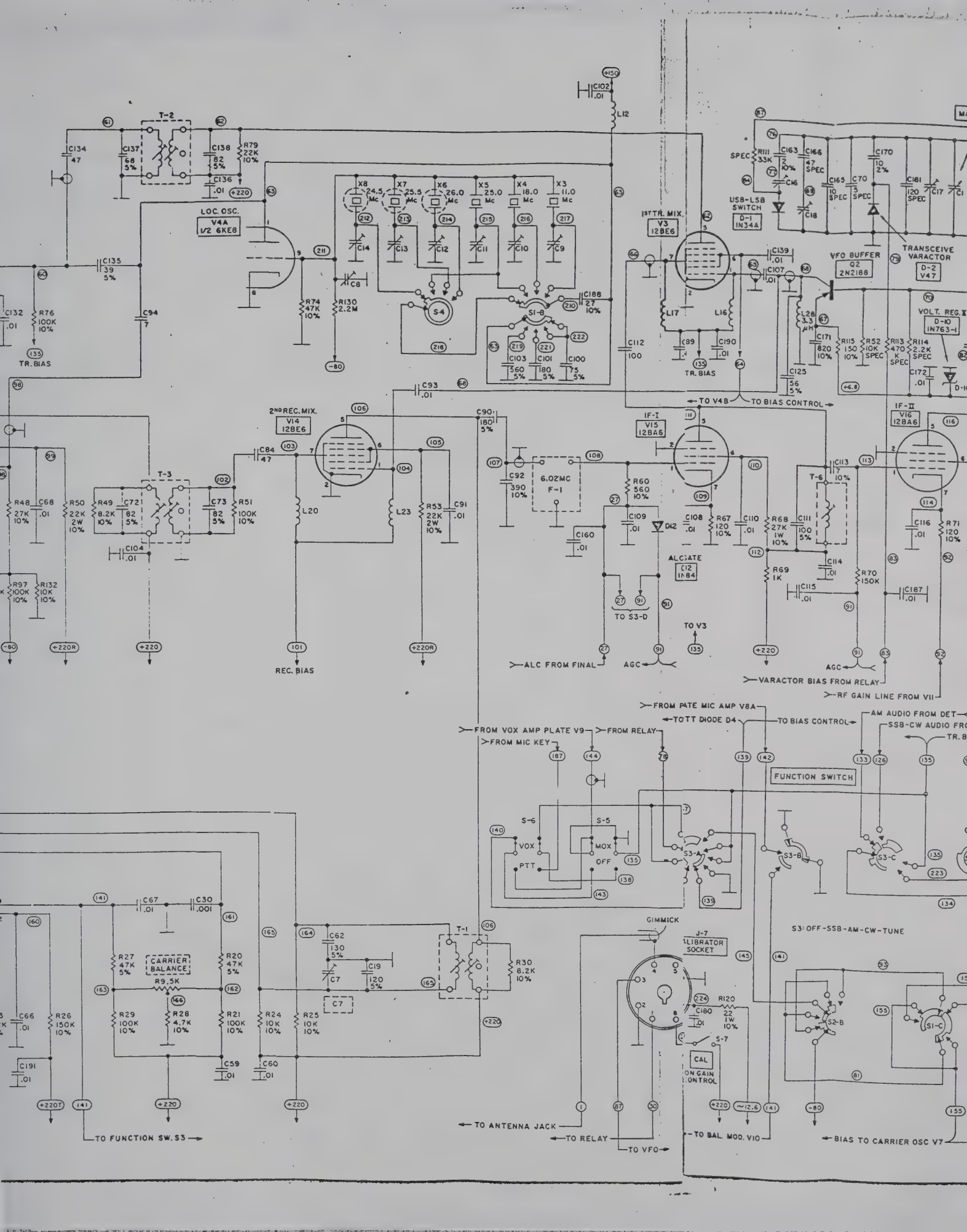
M	Meter	C50833
F-1	Filter, Xtal	A51557
D-2	Diode, Varactor	A51307-9
X1	Xtal, 6.0200 Mc	A51546-1
X2	Xtal 6.0234 Mc	A51546-2
X3	Xtal 11.000 Mc	A51555-1
X4	Xtal 18.000 Mc	A51555-2
X5	Xtal 25.000 Mc	A51555-4
X6	Xtal 26.000 Mc	A51555-6
X7	Xtal 25.500 Mc	A51555-5
X8	Xtal 24.5 Mc	A51555-3
Rel	Relay 6PDT 8000 ohms	A50798

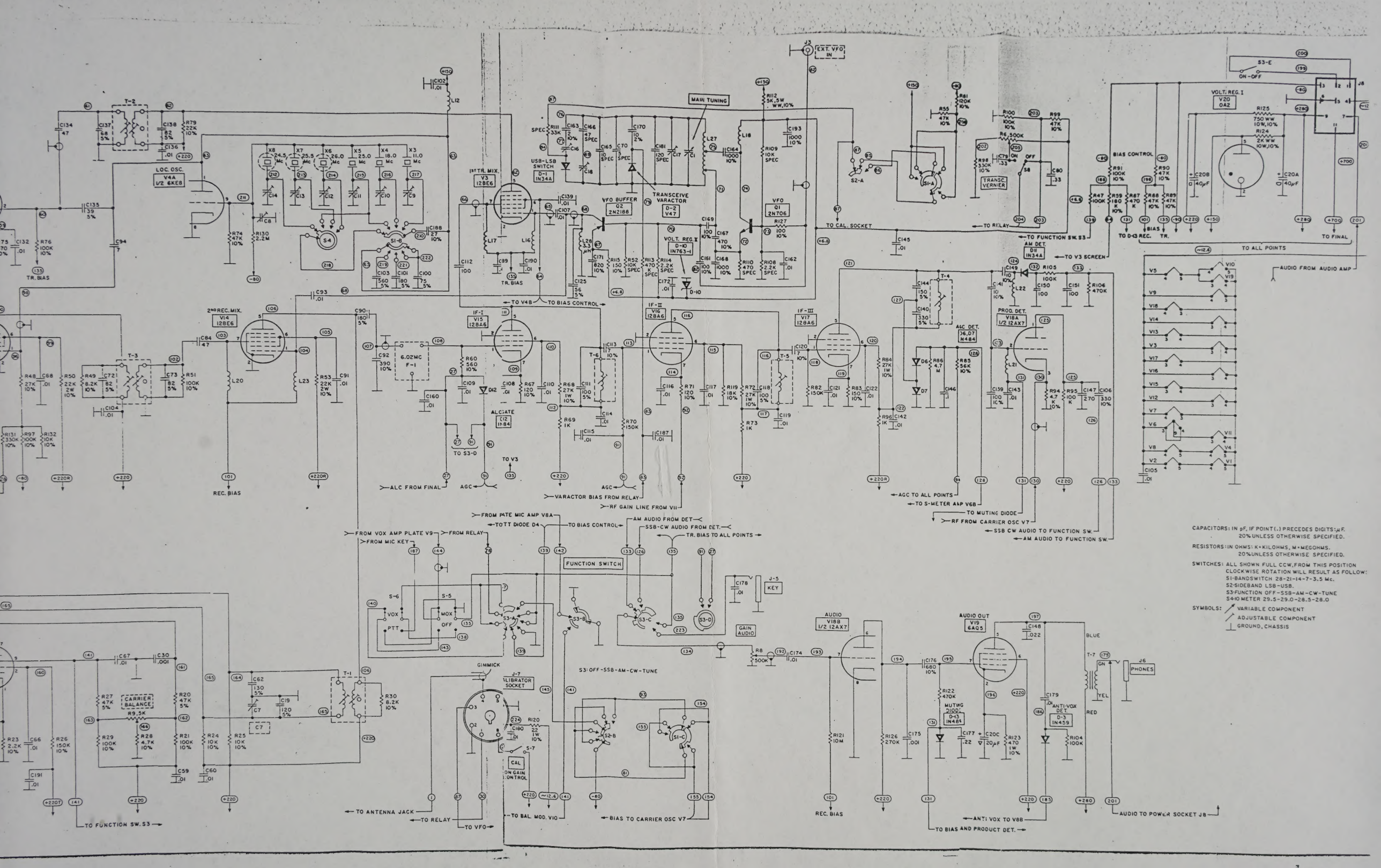
VOLTAGE AND RESISTANCE MEASUREMENTS (Cont)

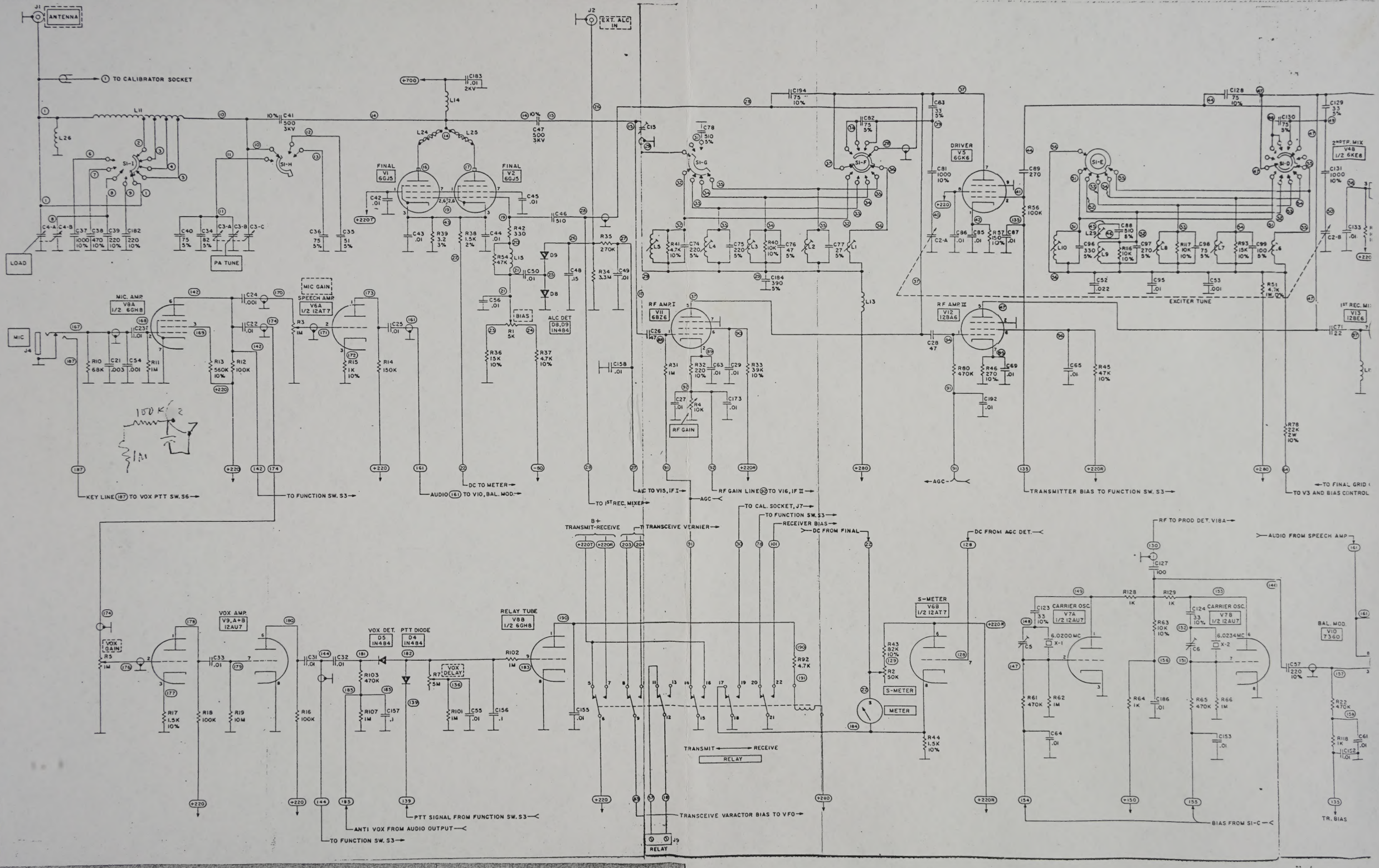
Tube	*Type*	*Function*	*Pin*	*Resistance*	*Voltage*	
					Receive	*Transmit*
V-7	12AU7	CARRIER OSCILLATOR	1	20 k	100	100
			2	300 k	0 LSB, −60 USB	0 USB, −60 LSB
			3	0	0	0
			4	—	12.6*	12.6*
			5	0	0	0
			6	20 k	100	100
			7	300 k	0 USB, −60 LSB	0 USB, −60 LSB
			8	0	0	0
			9	—	6.3*	6.3*
V-8	6GH8	MICROPHONE PREAMPLIFIER AND RELAY CONTROL	1	20 k	150	300
			2	1 meg	−1	−1
			3	600 k	35	35
			4	—	6.3*	6.3*
			5	—	12.6*	12.6*
			6	100 k	100	−.9
			7	0	0	0
			8	0	0	0
			9	1.5 meg	0	−40
V-9	12AU7	VOX AMPLIFIER	1	100 k	70	80
			2	800 k	0	0
			3	1.5 k	3	3
			4	0	0	0
			5	—	12.6*	12.6*
			6	100 k	35	40
			7	10 meg	−.7	−.7
			8	0	0	0
			9	—	6.3*	6.3*
V-10	7360	BALANCED MODULATOR	1	2.5 k	0	4
			2	150 k	0	200
			3	500 k	−40	0
			4	0	0	0
			5	—	6.3*	6.3*
			6	15 k	230	250
			7	15 k	250	250
			8	50 k	25**	25***
			9	50 k	25**	25**
V-11	6BZ6	1st RF STAGE	1	1 meg	0	0
			2	220 Ω	+1	0
			3	—	6.3*	6.3*
			4	—	12.6*	12.6*
			5	10 k	300	300
			6	80 k	150	0
			7	0	0	0
V-12	12BE6	2nd RF STAGE	1	470 k	0	0
			2	0	0	0
			3	0	0	0
			4	—	12.6*	12.6*
			5	15 k	270	250
			6	82 k	130	0
			7	270 Ω	2.7	0
V-13	12BE6	1st RECEIVER MIXER	1	150 k	−.5	−40
			2	0	0	0
			3	0	0	0
			4	—	12.6*	12.6*
			5	10 k	250	250
			6	56 k	200	0
			7	10 Ω	0	0

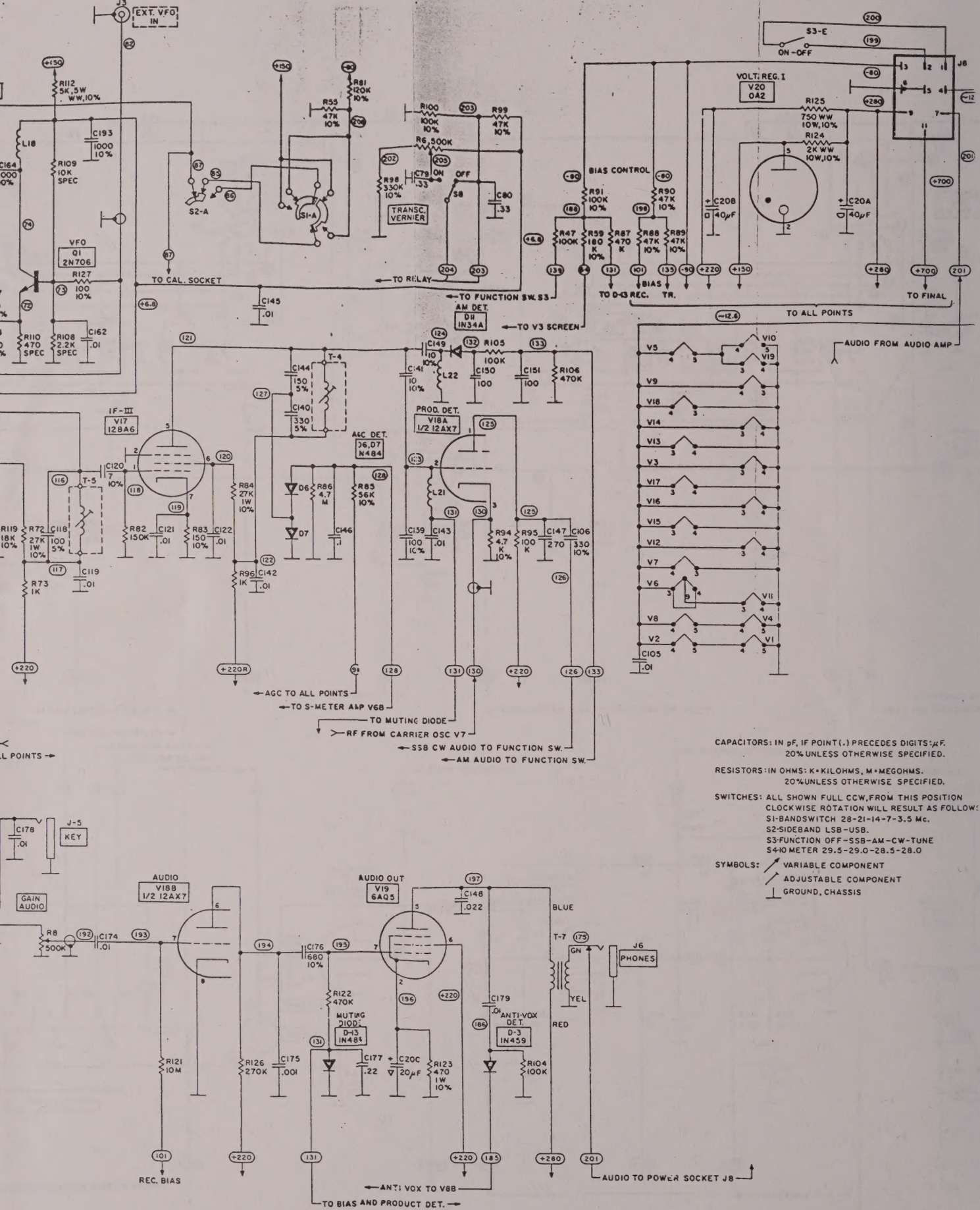
*AC OR DC DEPENDING ON SUPPLY
**+20 TO +30 VOLTS DEPENDING ON CARRIER BALANCE
***0 ON TUNE FUNCTION. +20 TO +30 DEPENDING ON CARRIER BALANCE


2ND TF MIX
V8
1/2 6KE8
LOC. OSC.
V4A
1/2 6KE8
1ST REC. MIX.
V13
12BE6
2ND REC. MIX.
V14
12BE6
BAL. MOD.
V10
7360
T-1
T-2
T-3
S1-D
S1-B
S1-C
S-4
S-5
S-6
X8 24.5 Mc
X7 25.5 Mc
X6 26.0 Mc
X5 25.0 Mc
X4 18.0 Mc
X3 11.0 Mc
C128 75 10%
C129 33 5%
C130 75 5%
C131 1000 10%
C132 .01
C133 .01
C134 47
C135 39 5%
C136 .01
C137 68 5%
C138 82 5%
C94 7
C99 100 5%
C100 75 5%
C101 180 5%
C102 .01
C103 560 5%
C104 .01
C109 .01
C112 100
C160 .01
C188 27 10%
R51 4.7K 1W 5%
R74 47K 10%
R75 470 10%
R76 100K 10%
R77 100K 10%
R79 22K 10%
R93 15K 10%
R130 2.2M
L12
L19
L20
L23
C14
C13
C12
C11
C10
C9
C8
C2-B
+150
+220
+220R
-80
+280
TR. BIAS
REC. BIAS
TO FINAL GRID COUPLING
TO V3 AND BIAS CONTROL
ALC FROM FINAL
AGC
TO S3-D
6.02MC F-1
C71 22
C72 82 5%
C73 82 5%
C84 47
C90 180 5%
C91 .01
C92 390 10%
C93 .01
R48 27K 10%
R49 8.2K 10%
R50 22K 2W 10%
R51 100K 10%
R53 22K 2W 10%
R60 560 10%
R78 22K 2W 10%
R97 100K 10%
R131 330K 10%
R132 10K 10%
AUDIO FROM SPEECH AMP
FROM VOX AMP PLATE V9
FROM MIC KEY
FROM RELA
VOX
MOX
PTT
OFF
C57 220 10%
C58 .01
C59 .01
C60 .01
C61 .01
C62 130 5%
C67 .01
C30 .001
C191 .01
C192 .01
C7 120 5%
C19 5%
R22 470K
R23 2.2K 10%
R24 10K 10%
R25 10K 10%
R26 150K 10%
R27 47K 5%
R28 4.7K 10%
R29 100K 10%
R30 8.2K 10%
R118 1K
R20 47K 5%
R21 100K 10%
R9.5K
CARRIER BALANCE
C7
+220T
TR. BIAS
TO FUNCTION SW. S3
TO ANTENNA JACK
TO RELAY
TO V
ROM S1-C


T-2
LOC. OSC.
V4A
1/2 6KE8
1ST TR. MIX.
V3
12BE6
VFO BUFFER
Q2
2N2188
TRANSCEIVE
VARACTOR
D-2
V47
USB-LSB
SWITCH
D-1
1N34A
VOLT. REG.
D-10
1N763-I
TR. BIAS
TO V4B
TO BIAS CONTROL
2ND REC. MIX.
V14
12BE6
T-3
REC. BIAS
IF-I
V15
12BA6
IF-II
V16
12BA6
6.0ZMC
F-1
T-6
ALC FROM FINAL
AGC
TO V3
VARACTOR BIAS FROM RELAY
RF GAIN LINE FROM V11
FROM PATE MIC AMP V8A
TOTT DIODE D4
TO BIAS CONTROL
AM AUDIO FROM DET
FROM VOX AMP PLATE V9
FROM RELAY
FROM MIC KEY
FUNCTION SWITCH
S-6
S-5
VOX
MOX
PTT
OFF
S3-A
S3-B
S3-C
S3: OFF-SSB-AM-CW-TUNE
CARRIER
BALANCE
R9.5K
T-1
GIMMICK
J-7
CALIBRATOR
SOCKET
S-7
CAL
TO FUNCTION SW. S3
TO ANTENNA JACK
TO RELAY
TO VFO
TO BAL. MOD. V10
BIAS TO CARRIER OSC V7


LOC. OSC.
V4A 1/2 6KE8
1ST TR. MIX.
V3 12BE6
MAIN TUNING
VFO BUFFER Q2 2N2188
TRANSCEIVE VARACTOR D-2 V47
VFO Q1 2N706
USB-LSB SWITCH D-1 IN34A
VOLT. REG. I D-10 IN763-1
VOLT. REG. I V20 0A2
TRANSC. VERNIER
BIAS CONTROL
EXT. VFO IN
S3-E ON-OFF
TO CAL. SOCKET
TO RELAY
TO FUNCTION SW. S3
TO V4B
TO BIAS CONTROL
TO V3 SCREEN
TO ALL POINTS
TO FINAL
AUDIO FROM AUDIO AMP
TO D-13 REC. TR. BIAS
TR. BIAS
2ND REC. MIX. V14 12BE6
IF-I V15 12BA6
IF-II V16 12BA6
IF-III V17 12BA6
AM DET. D11 IN34A
PROD. DET. V18A 1/2 12AX7
ASC DET. D6,D7 N484
6.02MC F-1
ALC GATE D12 1N84
TO S3-D
TO V3
REC. BIAS
ALC FROM FINAL
AGC
VARACTOR BIAS FROM RELAY
RF GAIN LINE FROM V11
AGC TO ALL POINTS
TO S-METER AMP V6B
TO MUTING DIODE
RF FROM CARRIER OSC V7
SSB CW AUDIO TO FUNCTION SW.
AM AUDIO TO FUNCTION SW.
FROM PATE MIC AMP V8A
TOTT DIODE D4
TO BIAS CONTROL
AM AUDIO FROM DET.
SSB-CW AUDIO FROM DET.
TR. BIAS TO ALL POINTS
FROM VOX AMP PLATE V9
FROM RELAY
FROM MIC KEY
FUNCTION SWITCH
S3-A
S3-B
S3-C
S3-D
S-5 MOX
S-6 VOX
PTT
OFF
J-5 KEY
GAIN AUDIO
S3: OFF-SSB-AM-CW-TUNE
GIMMICK
J-7 CALIBRATOR SOCKET
CAL
ON GAIN CONTROL
S-7
S2-A
S2-B
S1-A
S1-B
S1-C
CARRIER BALANCE
R9 5K
TO FUNCTION SW. S3
TO ANTENNA JACK
TO RELAY
TO VFO
TO BAL. MOD. V10
BIAS TO CARRIER OSC V7
AUDIO V18B 1/2 12AX7
AUDIO OUT V19 6AQ5
MUTING D10D2 D-13 IN484
ANTI-VOX DET D-3 IN459
J6 PHONES
AUDIO TO POWER SOCKET J8
ANTI VOX TO V8B
TO BIAS AND PRODUCT DET.
REC. BIAS
CAPACITORS: IN pF, IF POINT (.) PRECEDES DIGITS: μF. 20% UNLESS OTHERWISE SPECIFIED.
RESISTORS: IN OHMS: K=KILOHMS, M=MEGOHMS. 20% UNLESS OTHERWISE SPECIFIED.
SWITCHES: ALL SHOWN FULL CCW, FROM THIS POSITION CLOCKWISE ROTATION WILL RESULT AS FOLLOWS:
S1-BANDSWITCH 28-21-14-7-3.5 Mc.
S2-SIDEBAND LSB-USB.
S3-FUNCTION OFF-SSB-AM-CW-TUNE
S4-10 METER 29.5-29.0-28.5-28.0
SYMBOLS: VARIABLE COMPONENT
ADJUSTABLE COMPONENT
GROUND, CHASSIS


J1 ANTENNA
TO CALIBRATOR SOCKET
L11
L26
S1-I
S1-H
C41 500 3KV
C47 500 3KV
C183 .01 2KV
L14
L24
L25
FINAL V1 6GJ5
FINAL V2 6GJ5
+700
+2207
C42 .01
C43 .01
C44 .01
C45 .01
C46 510
R39 3.2 3%
R38 1.5K 2%
R42 330
R54 47K
L15
C50 .01
C48 .15
C49 .01
R34 3.3M
R35 270K
D9
D8
ALC DET D8,D9 1N484
BIAS
R1 5K
R36 15K 10%
R37 4.7K 10%
C158 .01
C56 .01
C40 75 5%
C34 82 5%
C3-A C3-B C3-C
C36 75 5%
C35 51 5%
C4-A C4-B
C37 1000 10%
C38 470 10%
C39 220 10%
C182 220 10%
LOAD
PA TUNE
J2 EXT. ALC IN
C15
C194 75 10%
C78 510 5%
C82 75 5%
S1-G
S1-F
C83 33 5%
DRIVER V3 6GK6
C81 1000 10%
C86 .01
C85 .01
R57 150 10%
C87 .01
R56 100K
C89 270
C2-A
C128 75 10%
C129 33 5%
C130 75 5%
S1-E
S1-D
2ND T.P. MIX V4B 1/2 6KE8
C131 1000 10%
C133 .01
C2-B
C88 510 5%
L29
L10
C96 330 5%
L9
R116 10K 10%
C97 270 5%
L8
R117 10K 10%
C98 75 5%
L7
R93 15K 10%
C99 100 5%
L6
C52 .022
C95 .01
C53 .001
R51 4.7K 1W 2%
EXCITER TUNE
C184 390 5%
L5
R41 4.7K 10%
C74 220 5%
L4
C75 220 5%
L3
R40 10K 10%
C76 47 5%
L2
C77 27 5%
L1
L13
RF AMP I V11 6BZ6
C26 47
R31 1M
R32 220 10%
C63 .01
C29 .01
R33 39K 10%
C27 .01
R4 10K
C173 .01
RF GAIN
RF AMP II V12 12BA6
C28 47
R80 470K
R46 270 10%
C69 .01
C192 .01
C65 .01
R45 47K 10%
1ST REC. MIX V13 12BE6
C71 22
L12
MIC
J4
MIC. AMP V8A 1/2 6GH8
C23 .01
R10 68K
C21 .003
C54 .001
R11 1M
C24 .001
C22 .01
R13 560K 10%
R12 100K
MIC GAIN
SPEECH AMP V6A 1/2 12AT7
R3 1M
R15 1K 10%
C25 .01
R14 150K
150K
1M
+220
+220R
+280
-90
KEY LINE 187 TO VOX PTT SW. S6
TO FUNCTION SW. S3
AUDIO 161 TO V10, BAL. MOD.
DC TO METER
TO 1ST REC. MIXER
AGC TO V15, IF I
AGC
RF GAIN LINE 92 TO V16, IF II
TO CAL. SOCKET, J7
TO FUNCTION SW. S3
RECEIVER BIAS
DC FROM FINAL
B+ TRANSMIT-RECEIVE
TRANSCEIVE VERNIER
DC FROM AGC DET.
TRANSMITTER BIAS TO FUNCTION SW. S3
AGC
R78 22K 2W 10%
TO FINAL GRID
TO V3 AND BIAS CONTROL
RF TO PROD DET. V18A
AUDIO FROM SPEECH AMP
VOX AMP V9, A+B 12AU7
VOX GAIN
R5 1M
C31 .01
C33 .01
C32 .01
R17 1.5K 10%
R18 100K
R19 10M
R16 100K
VOX DET. D5 1N484
PTT DIODE D4 1N484
R103 470K
R107 1M
C157 .1
R7 5M
VOX DELAY
R101 1M
C55 .01
C156 .1
RELAY TUBE V8B 1/2 6GH8
R102 1M
C155 .01
R92 4.7K
S-METER V6B 1/2 12AT7
R43 82K 10%
R2 50K
S-METER
METER
R44 1.5K 10%
TRANSMIT RECEIVE RELAY
J9 RELAY
PTT SIGNAL FROM FUNCTION SW. S3
ANTI VOX FROM AUDIO OUTPUT
TO FUNCTION SW. S3
TRANSCEIVE VARACTOR BIAS TO VFO
CARRIER OSC. V7A 1/2 12AU7
6.0200MC X-1
C5
C123 33 10%
R61 470K
R62 1M
C64 .01
CARRIER OSC. V7B 1/2 12AU7
6.0234MC X-2
C6
C124 33 10%
R63 10K 10%
R64 1K
C186 .01
R65 470K
R66 1M
C153 .01
R128 1K
R129 1K
C127 100
BAL. MOD. V10 7360
C157 220 10%
R22 470K
R118 1K
C152 .01
C61 .01
TR. BIAS
BIAS FROM SI-C


J3
EXT. VFO IN
S3-E
ON-OFF
J8
VOLT. REG. I
V20
0A2
R125
750 WW
10W, 10%
R124
2K WW
10W, 10%
BIAS CONTROL
R91
100K
10%
R90
47K
10%
+C20B
40μF
+C20A
40μF
R112
5K, 5W
WW, 10%
L18
C193
1000
10%
R109
10K
SPEC
VFO
Q1
2N706
R127
100
10%
R110
470
SPEC
R108
2.2K
SPEC
C162
.01
S2-A
S1-A
R55
47K
10%
R81
120K
10%
R100
100K
10%
R99
47K
10%
R6
500K
R98
330K
10%
C79
.33
ON
OFF
S3
C80
.33
TRANSC
VERNIER
TO CAL. SOCKET
TO RELAY
TO FUNCTION SW. S3
C145
.01
R47
100K
R59
180
K
10%
R87
470
K
R88
47K
10%
R89
47K
10%
TO D-13
REC. TR.
BIAS
TO FINAL
TO ALL POINTS
AUDIO FROM AUDIO AMP
AM DET.
D11
IN34A
TO V3 SCREEN
C149
10
10%
R105
100K
C141
10
10%
L22
C150
100
C151
100
R106
470K
IF-III
V17
12BA6
T-4
C144
150
5%
C140
330
5%
PROD. DET.
V18A
1/2 12AX7
AGC DET.
D6,D7
1N484
T-5
C120
7
10%
R84
27K
1W
10%
D6
R86
4.7
M
R85
56K
10%
D7
C146
.1
L21
C159
100
1%
C143
.01
R94
4.7
K
10%
R95
100
K
C147
270
C106
330
10%
R119
18K
10%
R72
27K
1W
10%
C118
100
5%
R82
150K
C121
.01
R83
150
10%
C122
.01
R73
1K
C119
.01
R96
1K
C142
.01
+220
+220R
AGC TO ALL POINTS
TO S-METER AMP V6B
TO MUTING DIODE
RF FROM CARRIER OSC V7
SSB CW AUDIO TO FUNCTION SW.
AM AUDIO TO FUNCTION SW.
V5
V10
V19
V9
V18
V14
V13
V3
V17
V16
V15
V12
V7
V6
V11
V8
V4
V2
V1
C105
.01
CAPACITORS: IN pF, IF POINT(.) PRECEDES DIGITS: μF.
20% UNLESS OTHERWISE SPECIFIED.
RESISTORS: IN OHMS: K=KILOHMS, M=MEGOHMS.
20% UNLESS OTHERWISE SPECIFIED.
SWITCHES: ALL SHOWN FULL CCW, FROM THIS POSITION
CLOCKWISE ROTATION WILL RESULT AS FOLLOWS:
S1-BANDSWITCH 28-21-14-7-3.5 Mc.
S2-SIDEBAND LSB-USB.
S3-FUNCTION OFF-SSB-AM-CW-TUNE
S4-10 METER 29.5-29.0-28.5-28.0
SYMBOLS:
VARIABLE COMPONENT
ADJUSTABLE COMPONENT
GROUND, CHASSIS
C178
.01
J-5
KEY
GAIN
AUDIO
R8
500K
C174
.01
AUDIO
V18B
1/2 12AX7
C176
680
10%
AUDIO OUT
V19
6AQ5
C148
.022
BLUE
T-7
J6
PHONES
GN
YEL
RED
R122
470K
MUTING
2100
D-13
1N484
C177
.22
C20C
20μF
R123
470
1W
10%
C179
.01
ANTI-VOX
DET.
D-3
1N459
R121
10M
R126
270K
C175
.001
R104
100K
REC. BIAS
ANTI VOX TO V8B
TO BIAS AND PRODUCT DET.
AUDIO TO POWER SOCKET J8